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Ayrin Sultana
Department of Finance and Banking
Hajee Mohammad Danesh Science and Technology University
Email: Ayrin.runu@hstu.ac.bd
Md. Abdullah-Al-Mamun*
Department of Finance & Banking
Bangabandhu Sheikh Mujibur Rahman Science & Technology University, Gopalganj.
Email: mamun1600.ju43@yahoo.com

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*Corresponding Author

Innovation-led Governance for Economic Development of Bangladesh

A strategic approach to public sector governance, innovation-led governance entails incorporating innovation into larger governance frameworks. Governments can boost innovation in a number of ways, such as investing in new technology or talents, using innovative approaches to governing, and modifying current procedures. Because it enables the conversion of scientific and technological advancements into profitable economic activity, innovation is a critical component of economic progress. This study is developed to examine the relationship between innovation and the economic development of Bangladesh. Financial Innovation, Trade Openness, Human Development Capital, Gross Capital Formation, and Domestic Credit to Private have been taken as an indicator of innovation measure where GDP measures the country's economic development. Financial Innovation, Trade Openness, Human Development Capital, Gross Capital Formation, and Domestic Credit to Private have been considered independent variables, and GDP as a dependent variable. This study used secondary data for analysis purposes. Secondary data has been collected from different websites (World Bank, World Bank Development Indicators, Bangladesh Bank, Bangladesh Bureau of Statistics). Several tests (Unit root test, Johansen Co-integrating test, Vector Error Correction Model, Impulse Response Function, ARDL, Bound test) are employed for secondary data analysis. All the variables are non-stationary at the level and stationary at the first difference. i.e., I (1). Johansen co-integrating test found that there is a long-term significant relationship between the dependent variable and independent variable. Further, the VECM and impulse response function (innovation accounting) calculate the Speed of Adjustment and find a short-term shock related to GDP. ARDL test and bound test showed that Trade Openness (TO), Human Development Capital (HD), and Gross Capital Formation (GCF) are positively correlated with GDP and negatively correlated with Financial Innovation and Domestic Credit to the Private Sector in the long run. To encourage technical innovation in domestic small enterprises, the Government-led Innovation initiatives (GIPs) are extremely competitive initiatives that give small businesses the chance to participate in Federal Research/Research and Development (R/R&D) with the possibility of commercialization. So, the Government should pay more attention to fostering economic development.

1.0 Introduction

Over the past few decades, innovation has been the most popular catchphrase. It typically involves the creation of an entirely original concept or the modification of an already-existing one, and occasionally it is sufficient to upend the entire system. However, pursuing novel concepts involves weighing the risks and opportunities. Innovation may not always succeed, but there are strategies to deal with that possibility. Bessant, Caffyn, and Gallagher (2001) considered the main theme for any economic development by considering continuous improvement (CI).

Innovation-led governance has been introduced in Bangladesh since 2018. Bangladesh benefits from innovation since it can contribute to inclusive and sustainable progress in the nation. The following are a few advantages of innovation in Bangladesh: growth in the economy (innovation has the power to boost productivity, launch new businesses, and generate employment), worldwide competitiveness (innovation can boost Bangladesh's global competitiveness and make it a more desirable place to invest), adoption of technology (Bangladesh may benefit from innovation by leveraging new trends and staying up to date with technical improvements), adaptability (Bangladesh may become more resilient to economic downturns, natural disasters, and other difficulties by embracing innovation, quality of life (by increasing efficiency in areas like communication, transportation, healthcare, and agriculture, innovation can raise Bangladesh's standard of living).

Fukuzawa and Inamizu (2017) discussed the multi-functional activities and the analysis of product life-cycle activities in the context of a sustainable innovation that can help Bangladesh's economic development. Cai (2012) put forward several policy suggestions relating to improvement in total factor productivity, expansion of human capital accumulation, and deepening of system and government function reforms. One of the largest exporters of semiconductors worldwide is Taiwan, which has the tenth most creative economy in the world. Similar to Bangladesh, Taiwan was heavily reliant on foreign funding for its development in the 1950s and 1960s. However, everything swiftly changed when Taiwan made the decision to adopt an innovative wealth-building approach. The privatization of government agencies lowered the likelihood of an economic slump by increasing system efficiency and prioritizing education, with a particular emphasis on innovation and engineering. They also realized they could never afford to remain stationary since other nations would soon overtake them and offer lower pricing.

Domb (1997) discussed innovation-led governance growth using parameters of the theory of inventive problem solving (TRIZ) creating an enabling business environment and promoting exports. Businesses can benefit from innovation in a number of ways, such as increasing output, cutting expenses, growing rivalry, increasing the value and recognition of a brand, increasing the value and recognition of a brand, forming new alliances and connections, and increasing revenue and earnings.

Moreover, Pesaran Shin and Smith (2001) expressed bounds testing approaches to the analysis of level relationships. Bangladesh has a much smaller and slower economy and has not pursued a similar policy change. We don't fully comprehend what innovation is. Most of us think of it as something along the lines of an extremely complex, unaffordable product. We don't consider value-added services, new market niches, or innovative approaches to outdated company models. We just don't want to cross lines. Thus, FDI to investing in human capital development, fostering knowledge acquisition, and embracing digital welfare and job satisfaction and eco-attributes in the area of sustainable innovation by the innovation-led governance growth using the seven global innovation pillars, i.e., creative outputs, knowledge and technology outputs, business sophistication, market sophistication, infrastructure, human capital, and research and institutions also regarding removing contradictory. This concept can be applied to progress the economic development of Bangladesh, to analyze bottlenecks in the economic growth (Eichengreen, Park, and Shin, 2012) of Bangladesh including competitive priority frame-

work that includes quality, cost, delivery, and flexibility. In order to review the efficacy of innovation policies for productivity growth and their implications for Bangladesh, it entails a data-driven and participatory problem-solving approach that capitalizes on the strengths of behavior change technology, as well as a clearly defined culture change process that can be systematically monitored and evaluated (Brown, 1996; Dejoy, 2005). It may also need to be expanded to include social responsibility with and the new priority growth of productivity, industrial productivity, services productivity, and quality of work life (QWL) for the country by the sustainable innovation in industry. With 160 million residents, Bangladesh ought to have been a profitable market for any investor. People interested in creating, purchasing, and consuming innovative items make up a sizable portion of the market. It requires innovation that is economical, scalable, reliable, and easy to use—all of which the manufacturers are unable to provide. Fukuzawa (2019) discussed lean manufacturing, which can link economic growth (per capita GDP), Financial Innovation, Trade Openness, Human Capital Development, Gross Capital Formation, and Domestic credit to the private sector are crucial to development.

2.0 Research background

Innovation-led governance is a philosophy to improve economic growth, seen as a practical example in Taiwan. Innovation-led governance is a concept that aims at developing economic growth and a developing country like Bangladesh needs to develop its economic growth. Innovation-led governance can obtain the analysis of the theory of inventive problem solving (TRIZ) (Chai, Zhang, and Tan, 2005), customer needs, and logical inferences, namely deduction, induction, and abduction for economic growth of Bangladesh (Ullah, Sato, Watanabe, and Rashid, 2016). Moreover, innovation-led governance can meet the fundamental human/citizen needs, i.e., subsistence, protection, affection, understanding, participation, leisure, creation, identity, freedom, esteem, and self-actualization. Accordingly, every need is linked with being-qualities, having-objects, doing-actions, and interacting set-things. Additionally, any innovation-led governance can consider fundamental human needs and requirements in the innovation process. Chai, Zhang, and Tan (2005) expressed TRIZ as a valuable tool for obtaining quality, productivity, and competitive advantage for the economic growth of Bangladesh (Zlotin, Zusman, Kaplan, and Visnepolschi, 2000).

3.0 Research objectives

The objectives are as follows:

- To study the effectiveness of innovation-led governance in Bangladesh.
- To measure economic growth using innovation-led governance.
- To identify the areas, where innovation-led governance in Bangladesh can be applied for the economic development of Bangladesh

4.0 Key variables, definitions, terms and terminologies

Key variables are GDP - Gross Domestic Product, FI - Financial Innovation, TO - Trade Openness, HD - Human Capital Development, GCF - Gross Capital Formation and DCP - Domestic Credit to Private Sector as defined in the Table 1.

5.0 Literature review

In reviewing the existing literature on innovation-led governance, several key findings emerge that underscore its significance in contemporary governance practices. Research indicates that innovative approaches not only enhance public service delivery but also foster greater

Table 1: Key variables, definitions, terms and terminologies

Variables	Terminology	Definitions
GDP (Dependent Variable)	Gross Domestic Product	Gross Domestic Product (GDP) is the total of the gross value added by all resident producers in the economy, plus any product taxes minus any subsidies not included in the value of the products. [World Bank]
FI	Financial Innovation	The ratio of broad money to narrow money expressed as a proportion of Gross Domestic Product (GDP). (Qamruzzaman, Jianguo, 2017)
TO	Trade Openness	Measures total trade (imports plus exports) as a percentage of Gross Domestic Product (GDP). [World Bank].
HD	Human Capital Development	Public funding aimed at enhancing the quality of education and advancing technical education. [recruiter.com]
GCF	Gross Capital Formation	Net improvement in capital growth is measured as physical investment as a percentage of Gross Domestic Product (GDP). [World Bank]
DCP	Domestic Credit to Private Sector	Represents the allocation of financial resources to the private sector, including bank loans, trade credit, and the purchase of non-equity securities, expressed as a percentage of Gross Domestic Product (GDP). [tradingeconomics.com]

Source: Authors' Calculation

citizen engagement and participation in decision-making processes. Moreover, the integration of technology within governance frameworks has facilitated more transparent and responsive systems, thereby addressing the challenges of bureaucratic inefficiencies. While the initial findings are promising, there remains a need for further investigation into the long-term impacts of such innovations on equity and social justice. Future research should focus on identifying best practices across diverse geopolitical contexts to understand better how innovation can be tailored effectively. Additionally, exploring the implications of emerging technologies on governance dynamics will be crucial for developing adaptable frameworks that

align with evolving societal needs, ultimately shaping sustainable governance for the future.

In order to successfully transfer, adapt, and execute innovations in governance and public administration, Alberti and Bertucci (2006) examined the processes, capacities, and environments needed. They assert that numerous intangible elements, such as collaborations and community involvement, are essential to the efficacy and longevity of innovation and new practices. For innovations to endure across a change in leadership, they must also be institutionalized. Additionally, the environment in which innovation occurs needs to be considered. The authors explored several benefits of implementing innovations in governance, including creating a more open culture in government, optimizing the use of resources and capacities, and enhancing services.

Government innovation faces several obstacles, both external (market-related) and internal (strategic). According to Garsombke and Garsombke (1989), there are several significant obstacles to innovation, including government red tape, a lack of government support, insufficient funds, people, time, and technological expertise, as well as complicated credit policies. These are important aspects for organizations that provide public services. Through top-down policy formation, bottom-up initiatives by managers and staff, and lateral adoption and adaptation of best practices, it is crucial to have a better understanding of the organizational processes of innovation (Tidd, 2001).

Non-autonomous innovation management, policy-unrelated innovation activities, fierce competition for innovation, workload, the weight of evaluation, resistance to change and innovation fatigue, and a negative attitude toward failure. The government's efforts alone will not suffice to remedy the issue. Therefore, society must promote an atmosphere that is more tolerant of failure. The main indigenous knowledge, foreign technology sources that must be modified for local conditions, the significance of the local dimension, the increased risk of isolation, problematic governance conditions (bureaucratic complexity, inadequate regulatory frameworks, and lax enforcement), a lack of infrastructure (transport and telecommunications), and limited resources are some of the unique innovation challenges for developing nations, according to Aubert and Quirke (2005).

Yoon (2006) focused on the Korean government's innovation methods and tactics. Five objectives have been recognized by the Korean government as essential to achieving its vision for innovation: efficiency, high quality of service, transparency, decentralization, and participation.

Kuwashima and Fujimoto (2013) found that for measuring innovation in product innovation or development, i.e., a product or service is either new or significantly enhanced included substantial advancements in technical specifications, components, materials, software, user experience, or other functional features.

Bulman, Eden, and Nguyen (2017) discussed that the determinants of growth at low- and high-income levels may be different. From this angle, where do creative concepts originate? They originate from a desire to learn. What will the innovation team do? Establishing a committee, holding a workshop to create an innovation strategy, developing a procedure, creating an instance, and tracking results. What does it mean to be resistant to innovation? Some of the coworkers have unfavorable attitudes. Positive dreams are therefore lost. They consistently create obstacles, and many employees refrain from speaking during meetings, particularly when the boss is present.

Accordingly, Lee, and Peterson (2000) discussed cultural resistance and obtaining global competitiveness. Thus, an Innovative program can be converted to an innovative culture. Innovators leverage existing processes or platforms to develop commercially successful products or processes that meet market demands. For example, the Toyota Production System/-Just-In-Time (JIT) approach effectively aligns with customer needs, ensuring demand is met efficiently. Kawai (2020), Terninko, Zusman, and Zlotin (1998) discussed TRIZ and "innovation" generally as changes in behavior. Innovation is adding value or new. Christian Boson, Head of Innovation at Mind Lab, Denmark's public sector innovation agency, defined public sector innovation as "the process of generating new ideas and transforming them into value for society." (Boson, 2008).

According to Borins (1998), internal problems within an agency or department were the most frequent drivers for innovation; Middle management and front-line levels contain many younger, often recent university graduates who are close to day-to-day operations as well as close to cutting-edge thinking. External pressure is regulation imposed on organizations to innovate; Influence from a Controlling body like a ministry; "competition combined with strong demand is a major driver of innovation".

Glawe and Wagner (2016) found that the developing nation has gotten a lot of attention in academic studies and political debates, especially when it comes to the growth performance of emerging market economies in Latin America and East Asia.

Gill and Kharas (2015) defined the middle-income range (MIR) and the middle-income threshold (MIT) in absolute or relative terms. The former is based on absolute middle-income standards, whereas the latter compares a country's per capita income to a reference develop country (typically the United States [U.S.]). But no agreement has been reached. The absolute thresholds of the middle-income range are defined differently in different studies.

Hudson (2003, 2007) explained that all factors and cultures that hinder innovation and safety in government as resistance to change; lack of effective legal structure; lack of autonomy, professionalism, and access to information; deference to authority; resource limitations (human or financial); and low regard for public administration. Innovation may also be hampered by economic factors (such as high costs or lack of demand), enterprise factors (such as lack of skilled personnel or knowledge), and legal factors (such as regulations or tax rules).

Islam and Uchiyama (2009) illustrated that innovation factors in agriculture sectors including knowledge factors, institutional factors, cost factors, market factors, legal factors, political factors, administrative factors, and social factors are the main factors that impede innovation and sustainable development. Knowledge factors include insufficient innovation potential, lack of qualified personnel, lack of an adequate management system, lack of advanced technology, and lack of information on technology and the market.

Ongori and Agolla (2008) expressed that organismal factors, innovation factors, and political factors may include the absence of democracy, confrontational politics, absence of strong political leadership, authoritarian approach by government, lack of accountability and transparency, and political corruption for economic development for any nations. Administrative Factors may include bureaucratic corruption, lack of strategic vision, bureaucratic complexity, centralized decision making, and politicization of the bureaucracy. Social Factors may include social instability and inequity, illiteracy, and lack of education.

6.0 Methodology and approach

All of the data has been collected from the website of the World Bank, World Bank Development Indicator, Bangladesh Bank, Bangladesh Bureau of Statistics. For Secondary data analysis following models has been used:

6.1 Regression model

$$LnYt = \alpha 0 + \beta 1 lnFIt + \beta 2 lnHDt + \beta 3 lnTOt + \beta 4 lnGCFt + \beta 5 lnDCPt + €t \quad [1]$$

Here α and β are the coefficient of variables

Yt represents the GDP per capita

ln Yt = Natural Logarithm of GDP per capita

ln FIt = Natural Logarithm of Financial Innovation

ln HDt = Natural Logarithm of Human Capital Development

ln TOt = Natural Logarithm of Trade Openness

ln GCFt = Natural Logarithm of Gross Capital Formation

ln DCPt = Natural Logarithm of Domestic Capital to Private Sector

€t = Error term.

In the above equation, GDP is the dependent variable and financial innovation, Human Capital Development, Trade openness, Gross Capital Formation, and Domestic Credit to private sectors are independent variables. The above-stated regression equation will show the linear relationship between dependent and independent variables.

6.2 Unit root test

This test measures the stationary. The Stationary time series data has equal/constant mean, variance, and autocorrelation over time.

The most used unit root test is the Augmented Dicky Fuller test (ADF).

Augmented Dicky-Fuller test (ADF) test:

ADF test equation can be written as following:

$$\Delta yt = \alpha 0 + \beta t + \gamma yt\text{-}1 + \delta 1 \Delta yt\text{-}1 + \ldots\ldots + \delta p\text{-}1 \Delta yt\text{-}p\text{-}1 + € \quad [2]$$

In the above equation, the null hypothesis is the data series being tested has a unit root i.e., stationary exists and the alternative hypothesis is no unit root exists.

6.3 Co-integration test

To examine the long-run equilibrium relation, Johansen co-integration test is employed. This study anticipated that there is a relationship between dependent and independent variables in the long run.

Null Hypothesis; H_0=No co-integration exists among the variables

Alternative Hypothesis; H_1=H_0 is not correct

6.4 Vector Error Correction Model

$$\Delta lnYt = \alpha 0 + \beta 1 \Delta lnFIt + \beta 2 \Delta lnHDt + \beta 3 \Delta lnTOt + \beta 4 \Delta lnGCFt + \beta 5 \Delta lnDCPt + \beta 6 ECTt\text{-}1 + \varepsilon t \quad [3]$$

The link among several time series variables is examined using the Vector Error Correction Model (VECM), particularly when the variables are non-stationary (meaning variance is not constant) at the level and exhibit a long-term equilibrium relationship.

Innovation Accounting: For capturing the short-run shocks impulse response function will be employed in this study.

6.5 The Autoregressive Distributed Lag (ARDL) Method

The study will apply a well-known approach by Pesaran et al. (2001) called the autoregressive distributed lag (ARDL) approach. The ARDL method is considered one of the best econometric models in cases when the variables are stationary at I (0) or integrated of order I (1). Based on the study objectives, it is a better model than others to catch the short-run and long-run impact of independent variables on economic development. While ARDL co-integration technique does not require pretests for unit roots, unlike other techniques. Consequently, the ARDL co-in

tegration technique is preferable when dealing with variables that are integrated of different order, I (0), I (1), or a combination of both and, robust when there is a single long-run relationship between the underlying variables in a small sample size.

6.6 Data management and analysis plan

In this study, Secondary quarterly data will be used from January 2012 to December 2023. In step 1 of data analysis, stationery will be checked using the Unit root test, and if the order of integration is I (0) or I (1) then the data analysis will be conducted; but if the order of integration is I (2) then the data cannot be analyzed. If the variables are stationary then the normal ordinary least square (OLS) test will be run and if non-stationary then the Co-integration test will be employed to capture the long-run relationship. If the variables are mixed (some stationary and some non-stationary) then the Autoregressive Distribution Lag (ARDL) test will be performed for data analysis and further Vector error Correction test (VECM) and Ganger Causality test will be employed as well.

7.0 Results and discussion

This study focuses on five independent variables: Financial Innovation, Human Capital Development, Trade Openness, Gross Capital Formation, and Domestic Credit to the Private Sector.

7.1 Descriptive statistics

The descriptive statistics for the six variables have been obtained for empirical investigation and are presented in the following Table. The variables are GDP, Financial Innovation, Trade Openness, Human Capital Development, Gross Capital Formation, and Domestic Credit to the Private Sector. The value of skewness and kurtosis indicates a lack of symmetry in the distribution. Financial innovation, Trade openness, Human Capital Development, Gross Capital Formation, and Domestic Credit to the Private Sector have negative skewness and a long left tail but GDP has positive skewness and a long right tail. High (>3) or low (<3) kurtosis values indicate leptokurtic or platykurtic. Here, all variables are platykurtic. If the skewness and kurtosis have a value of zero and 3, the data series is normally distributed. The value of standard deviation indicates that GDP and DCP are more volatile compared to FI, TO, HD, and GCF.

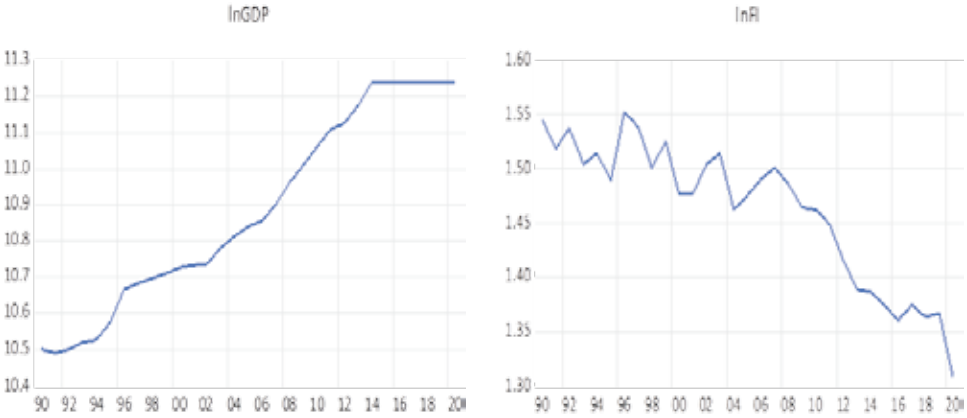
Table 2: Descriptive statistic

Terminology	LNGDP	LNFI	LNTO	LNHD	LNGCF	LNDCP
Mean	10.88316	1.462224	1.552490	1.089837	1.38769	1.456671
Median	10.84161	1.476976	1.547774	1.113965	1.41456	1.466675
Maximum	11.23777	1.55145	1.682235	1.214844	1.50543	1.67780
Minimum	10.49080	1.30963	1.37680	.903090	1.20453	1.161368
Std. Dev	.268557	.065550	.089341	.08431	.08421	.173389
Skewness	.064871	-.66353	-.062771	-.64543	-.68765	-.223584
Kurtosis	1.596942	2.30671	1.938168	2.47678	2.43986	1.63125
Jarque-Bera	2.564482	2.89674	1.476696	2.51457	2.80317	2.678052
Probability	.277415	.234980	.477903	.284637	.24652	.262101
Sum	337.3778	45.32893	48.12785	33.78493	42.93407	45.15635
Sum Sq. Dev.	2.163680	.128907	.23896	.20812	.216465	.901908
Observations	48	48	48	48	48	48

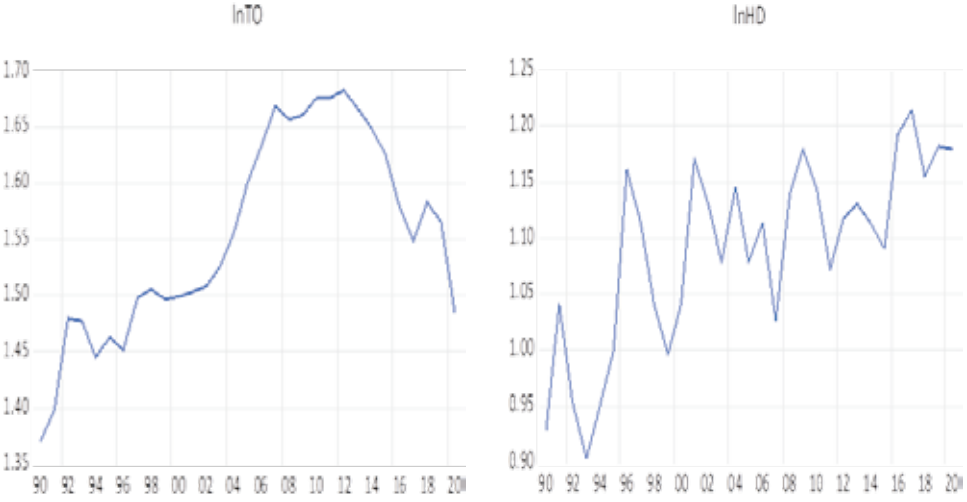
Source: Authors' Calculation

The first and simplest method for checking whether the variables are stationary or not, is the graphical representation which observes mean, variance, autocorrelation and seasonality shown in the first data set graph. The pattern of the data set indicates that all of the variables are non-stationary as their mean is different at different points in time. The non-constant mean of the variables proves the non-stationary nature of the variables. The evidence is further investigated by employing the ADF test which is the formal procedure for checking stationarity.

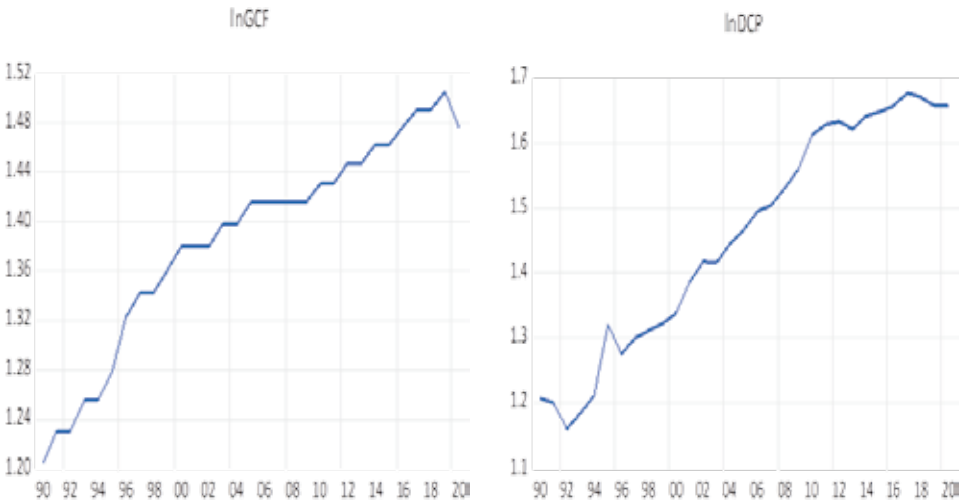
Figure 1: Data-set Graph for six variables, i.e., GDP, FI, TO, HD, GCF and DCP



Source: Authors' Calculation

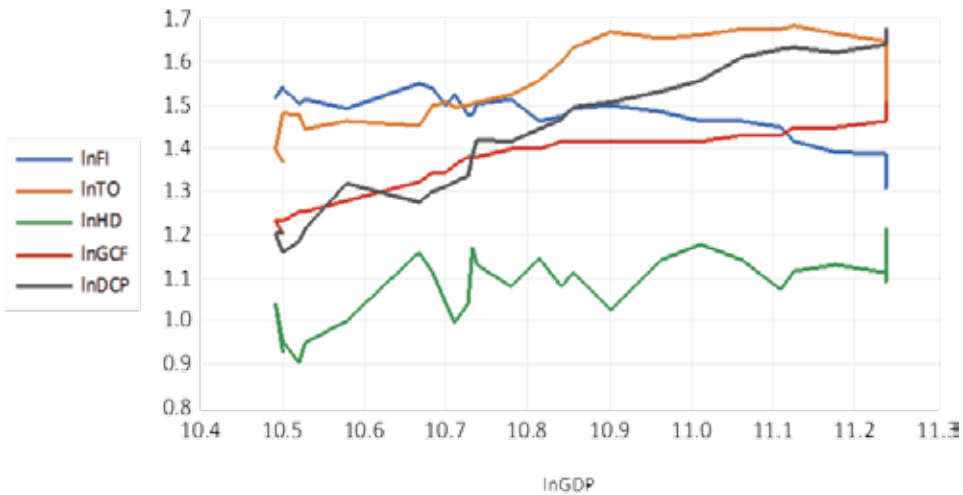


Source: Authors' Calculation



Source: Authors' Calculation

Figure 2: Data-set Graph for Comparison five variables, i.e., FI, TO, HD, GCF and DCP with respect to GDP



Source: Authors' Calculation

7.2 Unit root test

The following table reveals that all the variables are non-stationary in levels with intercept. The variables are non-stationary because they accept the null hypothesis i.e., the presence of unit root in level. In the first difference, all the variables are stationary at 1, 5, and 10 percent levels of significance. Stationarity is important in research to accurately analyze and predict the data. The researcher should check it in level, in first differences, and in second differences until stationarity is found. This type of data series is called I (1) as they are integrated into the order I (1). Next, Johansen co-integration test is employed for investigating the long-term relation between dependent and independent variables.

Table 3: Unit root test

Variables	ADF test result	P value	Comments	Order of integration
LnGDP	-1.182335	.6682	Failed to reject the null hypothesis (h0)	
D(lnGDP)	-3.318675	.0232	Rejected null hypothesis(h0)	I (1)
LnFI	-.168563	.9323	Failed to reject the null hypothesis (h0)	
D(LNFI)	-7.101920	.0000	Rejected null hypothesis(h0)	I (1)
LnTO	-1.682614	.4292	Failed to reject the null hypothesis (h0	
D(lnTO)	-3.089989	.0385	Rejected null hypothesis(h0)	I (1)
LnHD	-2.856966	.0625	Failed to reject the null hypothesis (h0)	
D(lnHD)	-5.949011	.000	Rejected null hypothesis(h0)	I (1)
LnGCF	-2.700883	.0860	Failed to reject the null hypothesis (h0)	
D(lnGCF)	-5.179516	.0002	Rejected null hypothesis(h0)	I (1)
LnDCP	-.884627	.7791	Failed to reject the null hypothesis (h0)	
D(lnDCP)	-5.803172	.000	Rejected null hypothesis(h0)	I (1)

Source: Authors' Calculation

*Null Hypothesis (h0) = Each variable has a unit root

7.3 Lag length criteria

As the regression model is sensitive to the lag length chosen, so the appropriate lag length has to be ascertained before running the co-integration test.

Table 4: Lag length criterion

Endogenous variables: LNGDP LNFI LNTO LNHD LNGCF LNDCP						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	294.9590	NA	8.92e-17	-19.92828	-19.19022	-19.27806
1	447.0877*	231.0647	3.08e-17*	-28.80702*	-25.92651*	-27.45351*
2	485.6155	41.5567	3.73e-17	-27.79550	-24.18124	-26.14740

Source: Authors' Calculation

*Indicates lag order selected by the criterion

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion.

The study determines the optimal lag based on minimum LR, FPE, AIC, Schwarz information criterion (SC) and HQ. All the statistics suggested one lag length. Table 4 proves that. All of the statistics confirmed that except LR (in Table 4). Therefore, the study selects a lag length of one for further analysis.

7.4 Johansen Co-integration Test

The result of Johansen Trace statistics and Max-Eigen statistics is shown in Table 4 using a 5% significance level. The table shows that in the trace test, there are two co-integrating equations but one co-integration in the Max-Eigen test.

Table 5: Johansen Co-integration test

Series: LNGDP LNFI LNTO LNHD LNGCF LNDCP						
Null Hypothesis	Trace statistic	Critical value (5%)	Comment (According to trace statistic)	Max-Eigen Statistic	Critical value (5%)	Comment (According to Max-Eigen Statistic)
r ≤ 0	137.7119*	107.81889	Rejected h0	53.74828*	43.87687	Rejected h0
r ≤ 1	81.59531*	79.85613	Rejected h0	33.02720	37.58434	Failed to reject h0
r ≤ 2	51.56811	55.79707	Failed to reject h0	24.00993	30.13162	Failed to reject h0
r ≤ 3	25.558184	35.49471	Failed to reject h0	18.29879	24.26460	Failed to reject h0
r ≤ 4	6.328305	18.841465	Failed to reject h0	6.328305	17.841465	Failed to reject h0

Source: Authors' Calculation

Note: * denotes the rejection of null hypothesis

The trace test indicates two co-integrating equations at the .05 level.

Max-Eigen test indicates one co-integrating equation at the .05 level is lower than .05 than rejected the null hypothesis. Now, the study concerns which of the two tests (Trace test and Max-Eigen) is superior. According to many scholars' the trace test is superior to Max-Eigen (Helmut Lutkepohl, Pentti Saikkonen & Carsten Trenkler, 2001). Therefore, there exists a long-term relation between dependent variables (GDP) and independent variables (FI, TO, HD, GCF, DCP).

Table 6: Co-integration Equation

Normalized co-integrating coefficients (Standard error in parentheses)					
LNGDP	LNFI	LNTO	LNHD	LNGCF	LNDCP
1.0000000	6.064914	-5.428797	-4.088869	1.318600	6.709360
	(1.10059)	(.60408)	(.48818)	(.93592)	(.85633)

Source: Authors' Calculation

7.5 Interpretation of Co-integration Equation

From the co-integration equation, it can be concluded that there is a long-term relationship among dependent and independent variables. Financial Innovation and Trade openness have a positive relationship with GDP. On the other hand, Human development capital, Gross capital Formation and Domestic Credit to private sectors are negatively correlated with GDP in the long run which is shown in the following table.

Table 7: Long term Co-integrating relationships

Co-integra-ting equation	LNGDP 1.0000000	LNFI 6.064914	LNTO -5.428797	LNHD -4.088869	LNGCF 1.318600	LNDCP 6.709360
Dependent variable (lnGDP)	Independent variables					
	LNFI	LNTO	LNHD	LNGCF	LNDCP	
Long term coefficient elasticity	6.064914	-5.428797	-4.088869	1.318600	6.709360	
Coefficient	-6.064914	5.428797	4.088869	-1.318600	-6.709360	
Comment (In terms of long-term equilibrium)	Negative relation with dependent variable	Positive relation with dependent variable	Positive relation with dependent variable	Negative relation with dependent variable	Negative relation with dependent variable	

Source: Authors' Calculation

7.6 Vector Error Correction Model

Error Correction:	D(LNGDP)	D(LNFI)	D(LNTO)	D(LNHD)	D(LNGCF)	D(LNDCP)
Coint. Eq 1	.011779	-.018116	.009988	.089230	.000357	-.022430

Source: Authors' Calculation

The GDP Adjustment speed is 1.17%, which implies that the previous period's (month) deviation from long-run equilibrium is corrected at a speed of 1.17%. The speed of adjustment (SOA) is the time it takes to move from one set of macroeconomic variables to another, and is important for policymakers in research because it can help with the sequencing of economic reforms:

Economic reform sequencing: SOA can help policymakers sequence economic reforms, such as reducing tariffs and quotas, increasing innovational investment, and asking for new project proposals from the researcher to generate new ideas. For example, policymakers can convert quotas to tariffs to reduce the cost of protection.

Welfare economics: SOA can help policymakers analyze the contribution of welfare economics and political economy to policy sequencing.

Operational research methods: SOA can help policymakers analyze policy sequencing through operational research methods, such as critical path analysis (CPA).

The adjustment speeds are 1.17%, 1.18%, .9%, 8.9%, .03% and 2.2% respectively towards long-run equilibrium in case of disequilibrium.

Table 8: Short term relationship

Variables	Speed of Adjustment	Comment
$\Delta \ln GDP_{t-1}$	1.17%	Inverse relation with GDP in short run
$\Delta \ln FI_{t-1}$	1.18%	Positive relation with GDP in short run
$\Delta \ln TO_{t-1}$	.9%	Positive relation with GDP in short run
$\Delta \ln HD_{t-1}$	8.9%	Positive relation with GDP in short run
$\Delta \ln GCF_{t-1}$	.03%	Positive relation with GDP in short run
$\Delta \ln DCP_{t-1}$	2.2%	Inverse relation with GDP in short run

Source: Authors' Calculation

7.7 Impulse Response Function

Impulse response functions (IRFs) are used to analyze the effects of a shock on economic variables over time. When interpreting IRFs, you can consider the following:

Direction: The direction of the response

Magnitude: The size of the response

Persistence: How long the response last

Figure 3: Innovation Accounting

Source: Authors' Calculation

7.7.1 Interpretation of SD shocks to LNGDP

Shocks to LNGDP will have an appositive impact on their own both in the short run and long run.

Response to LNFI: A one SD shock (innovation) to lngdp has a gradual declining trend until 3rd period on LNFI. After the 3rd period, it gradually rises but remains in the negative region until the 9th period.

Shocks to lngdp will have a negative impact on lnfi in both SR and LR. This means that due to less investment in financial innovation, the GDP of Bangladesh is declining comparatively.

Response to LNTO: A one SD shock (innovation) to lngdp has a negatively stable trend from the 1st period until the 10th period in the negative region. Shocks to lngdp will have a negative impact on lnto in both SR and LR. This means the higher the trade openness the better it is for increasing GDP.

Response to LNHD: lnhd has a diminishing trend until the 2nd period and stable up to the 10th period but remains in the positive area. So, innovation to lngdp will have a positive impact on lnhd in the short run and long run. Human development is important for generating innovation to a certain point and moving GDP upward.

Response to LNGCF: Shocks to lngdp have gradually declined from to 1st period to the 10th period but in the positive area. So, innovation to lngdp will have a positive impact on lngcf in the short run and long run. The higher the capital available the better the business investment so GDP to a certain extent.

Response to LNDCP: A one SD shock (innovation) to lngdp has a gradually declining trend from the 3rd period on LNFI to the 10th. Shocks to lngdp will have an appositive and low symmetric impact on lndcp in both SR and LR.

7.8 ARDL Test

According to the ARDL test and bound test, there is a long-run relationship between the dependent variable (GDP) and Independent Variables (FI, TO, HD, GCF, DCP). In table (7 and 8) Trade openness (TO), Human Development Capital (HD) and Gross capital Formation (GCF) is positively correlated with GDP and negatively correlated with Financial Innovation and Domestic Credit to Private Sector in the long run. Here, R squared is 99.71% and p-value is .0000, which means that the dependent variable is very well represented by the independent variables and the model is good enough to explain the relationship. So, there is no autocorrelation and the statistics are significant.

Table 9: ARDL Test

Dependent Variable: LNGDP
Method: ARDL
Dependent lags: 1 (Fixed)
Dynamic regressors (1 lag, fixed): LNFI LNTO LNHD LNGCF LNDCP
Fixed Regressors: C

Variable	Coefficient	Std. Error	t-statistics	Probability*
LNGDP (-1)	.644701	.1192345	5.412914	.00000
LNFI	-.289042	.238052	4.214199	.024211
LNFI (-1)	-.023705	.177789	3.133414	.04538
LNTO	.146543	.075671	-.882651	.02318
LNTO (-1)	.476781	.098764	2.730925	.12945
LNHD	.057089	.078901	.730253	.04567
LNHD (-1)	.134210	.088180	1.504765	.04732
LNGCF	-.678901	.345670	1.928742	.09876
LNGCF (-1)	-.810122	.315679	-2.55678	.87650
LNDCP	-.023456	.158292	-.177890	.05876
LNDCP (-1)	-.324567	.172295	1.909875	.03219
C	3.377253	1.352733	2.498765	.02346

R squared	.997172
Adjusted R-squared	.995443
S.E. of regression	.017779
Log likelihood	85.98604
F-statistics	576.9305
Prob (F-statistics)	.000000
Mean Dependent variance	10.89594
S.D. dependent var	.263382
Akaike info criterion	-4.934568
Schwarz criterion	-4.37653
Hannan-Quinn criterion	-4.57689
Durbin-Watson stat	1.795832

Source: Authors' Calculation

*Note: p-values and any subsequent tests do not account for model selection.

From the bound test, the study found that there is a relationship between GDP and innovation, which is consistent with the hypothesis. So, fostering trade openness, increasing investment in innovation, domestic credit to the private sector, capital formation and increasing human intellectual through training is important for increasing the GDP of Bangladesh.

Table 10: Bound Test

ARDL Long run form and Bounds Test
Dependent Variable: D(LNGDP)
Method: ARDL (1, 0, 1, 1, 1, 1)
Included Observation: 47

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-statistics	Probability*
C	3.32902	1.2694	2.622516	.0000
LNGDP (-1)	-.352949	.1147345	-3.076885	.0168
LNFI**	-.293523	.228052	-1.274199	.00621
LNTO (-1)	.318502	.177789	-183414	.034538
LNHD (-1)	.186543	.085671	1.882651	.04318
LNGCF (-1)	-.376781	.118764	-.830925	.13945
LNDCP (-1)	-.157089	.168901	1.870253	.04567
D(LNTO)	.164210	.158180	-.984765	.01732
D(LNHD)	.058901	.075670	.738742	.11876
D(LNGCF)	-.770122	.135679	2.05678	.04650
D(LNDCP)	-.027456	.154092	-.177890	.03876

**Variable interpreted as Z= Z (-1) + D (Z)

Levels Equation, Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-statistics	Probability*
LNFI	-.831628	.505364	1.642516	.01163
LNTO	.902400	.395700	2.286885	.03431
LNHD	.531980	.337046	1.574199	.00421
LNGCF	-.387451	.496285	.788414	.04446
LNDCP	.869857	.378537	2.29651	.03311
C	9.432023	.822103	11.47305	.000000

Source: Authors' Calculation

7.9 Target Equation

EC= LNGDP-(-.831628*LNFI+.902400*LNTO+.531980*LNHD-.387451*LNGCF-.869857*LNDCP+9.432023)

7.10 Overall Findings

This study revealed that there is a long-term relationship between GDP and Financial innovation (FI), Trade openness (TO), Human Development capital (HD), Gross capital formation (GCF), and Domestic credit to the private sector (DCP) which is statistically significant as R-squared is 99.71% and p-value is .00000. There is a positive relationship between TO and HD with GDP which is consistent with the findings of Subhan Tahrima and Don Jaegal (2012), Sajal K Palit (2006), Mario Pansera (2014), Md. Mamunur Rashid & Md. Abdullah-Al-Mamun (2024) and Ananda Majumdar (2019) i.e., The more the country's export increases, the more the GDP flows will be. The nation's investment in talent development also promoted economic expansion. On the other hand, FI, GCF, and DCP are negatively associated with GDP, which is consistent with Biru Paksha Paul (2011), Habibul Haque Khondker (2017), and A S M Mostafizur Rahman (2024). This indicates that an increase in broad money (M2) or public loans may hinder economic development.

8.0 Conclusion

Bangladesh and other developing countries need to follow innovative approaches in various sectors. Innovations can lead to new institutions, change the relationship between levels of government and within government departments, and strongly contribute to the democratization of institutions and processes. Due to methodological limitations, time constraints, insufficient data or information, limitations in sampling, research design limitations, bias of the researcher, and confounding variables, the study was not able to address other macro variables and broader concepts of innovation.

Innovation cannot be sustained or generated on its own. Leadership is necessary for successful innovation in order to build organizational capacity for idea generation and to guarantee efficient and timely service. The innovation process won't be successful if any government doesn't offer these. Innovation, at the government level, means the formulation of adequate policies to attract foreign investment, create an innovation culture, facilitate the integration of new technologies, support innovative small and medium-sized enterprises (SMEs) and creators, and produce market innovations. Bangladeshis have historically demonstrated innovation out of necessity rather than luxury or external recognition. This study meets the first objectives of this paper.

Here, Financial Innovation, Trade openness, Human Development Capital, Gross capital Formation and Domestic Credit to the Private sector are the indicators of innovation and GDP is the measure of economic development. From the secondary data, the paper concludes that there is a long-term as well as a short-term

relationship between dependent variables (GDP) and independent variables (Financial Innovation, Trade openness, Human Development Capital, Gross capital Formation and Domestic Credit to the Private sector) which is statistically significant. Again, Trade openness and Human Development Capital are positively correlated with GDP, and Human Development Capital, Gross Capital Formation and Domestic Credit to the Private Sector are negatively correlated with GDP. This meets the second objective.

Generally, the wealthiest nations and regions of the world are the most innovative, and innovation is a renewable source of wealth. However, in Bangladesh, the concept of innovation in government remains obscure. Bangladesh faces political, administrative, economic, and social barriers to innovation. Keeping these in mind, this paper proposes an innovation strategy for the Bangladesh government. Bangladesh is a third-world country, but also a democracy. The Bangladesh government is committed to building a secular, progressive, democratic, knowledge-based modern welfare state. The present democratic government has declared in its "Vision 2041" to establish Bangladesh as a resourceful and modern country by 2041. Consequently, it is important to stimulate, support, and carefully nurture the spirit of creativity and innovation. Government innovation means initiating new and creative plans, policies, and strategies to bring change to the administrative sector, accelerate the market economy, and bring stability to politics and society. In terms of government innovation and sustainable development, Bangladesh, as a developing country, has a long way to go. This meets the third objective.

The government should focus on innovation; innovation has to be emphasized in the governmental policy and the country's development scheme. For economic development, innovation plays a major role. For the overall development, innovation has to be ensured. The government has to invest a higher percentage of its budget in education, technological advancement, and research sectors, than skilled persons can get. Thus, economic development can get. Need to complete the mega project at the earliest time, i.e., within the stipulated time as well as control the inflation rate positively. Innovation means more products that lead to industrialization and more employment creation. Innovation improves the standard of living. Economic development enhances economic development and, the overall development of the country's sectors. Innovation is the key indicator of economic development. Govt. has to increase trade openness and exports for economic development. The government has to facilitate agriculture mechanization, industrialization, and increasing domestic production in all sectors, especially agriculture. Additionally, the government has to emphasize human resource development, technical education rather than conventional education, more investment in production-based industry, and proper budgeting and implementation of the budget. The government has to be more attentive in the context of innovation and economic development, to take more initiative. Accordingly, people become more innovative which will lead us economically to meet our objectives. In Bangladesh, innovation and economic development are not highly supported by the concerned authority. People in Bangladesh need to be backed by the government. To obtain more patents and innovation is to need investment in research and development. The government has to improve the educational quality from primary to university levels. The government has to try to reduce corruption. The government has to try to provide the best services to investors. Bangladesh has yet to pursue a similar policy shift and remains stuck with a much smaller and sluggish economy. The concept of alert innovation is still not well understood in Bangladesh.

Bangladesh has to give attention or our governments have to give more attention regarding innovation for the economic betterment or sustainability of our economy. Bangladesh cannot go to future better development only by exporting our textile sector and exporting our manpower. Bangladesh can be seen first-world country always busy with some innovation they contribute major GDP by the innovation of some things. Becoming an entrepreneur creates employment opportunities and develops the country. The government can boost innovation through five key actions: simplifying business startup processes, increasing loan availability, and prioritizing innovation in science and technology to achieve sustainable development. Since GDP is no longer a reliable indicator of human development, it will never be a worry. Focus can be given to education, innovation, sustainable human development, and ICT. Innovation driver economic development is to be highly sustainable. All steps of innovation lead to economic development. Consequently, there are some steps, i.e., to increase human resources, to develop our education system, to develop our technical part for economic development. This meets the fourth objective.

This study may help government policymakers and other investors to encourage investment in innovation-driven projects to foster the country's GDP in the long run. Future research may help to accommodate all other macro variables that represent innovation along with GDP through the cross-sectional data set.

9.0 References

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